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INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LGS-5A SERIES

MP MASTER



MA28617



LAMBDA

LAMBDA ELECTRONICS

MELVILLE, L. I., N. Y.



**INSTRUCTION MANUAL
FOR
REGULATED POWER SUPPLIES**

LGS-5A SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LGS-5A models unless otherwise specified.

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IM-LGS-5A

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SPECIFICATIONS AND FEATURES

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°	50°	60°	71°
LGS-5A-5-OV-R	5±5%	55	46	36	22
LGS-5A-6-OV-R	6±5%	46.5	39.5	31.5	20
LGS-5A-12-OV-R	12±5%	26	23	19	14
LGS-5A-15-OV-R	15±5%	22	19.2	16	12
LGS-5A-20-OV-R	20±5%	15.5	14	12	8.5
LGS-5A-24-OV-R	24±5%	13.5	12.5	10.5	7.5
LGS-5A-28-OV-R	28±5%	11.5	10.5	9.5	6.8

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for the entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation 0.1% line or load with input variations from 105-132 or 132-105 volts AC and load variations from no load to full load.

Ripple and Noise 10mV RMS, 35mV peak-to-peak for LGS-5A-5-OV-R, -6-OV-R models; 15mV RMS, 100mV peak-to-peak for LGS-5-12-OV-R, -15-OV-R, -20-OV-R, -24-OV-R, and -28-OV-R with either positive or negative terminal grounded.

Temperature
Coefficient Change in output voltage .03%/°C max.

Remote Programming

External Resistor Nominal 1000 ohms/volts output.

Programming voltage One-to-one voltage change.

Remote Sensing Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

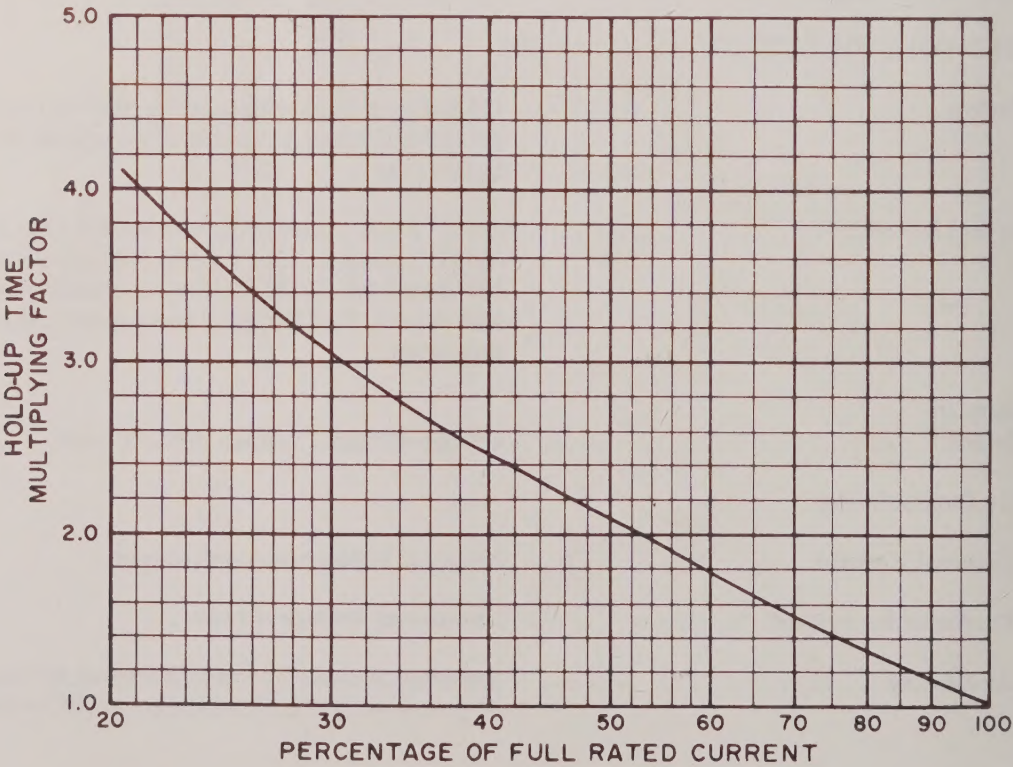
HOLD-UP TIME — Determine hold-up time regulation after input power failures as follows:

- 1. Find hold-up time at full rated current from chart below.
- 2. Determine percentage of full rated current for desired application.
- 3. Find multiplying factor on graph below.
- 4. Apply hold-up time formula:

$S = (F) (M)$

where S = hold-up time
 F = hold-up time at full rated current (see chart)
 M = multiplying factor (see graph)

MODEL	HOLD-UP TIME (ms) AT FULL RATED CURRENT
LGS-5A-5-OV-R	16.5
LGS-5A-6-OV-R	16.5
LGS-5A-12-OV-R	5.0
LGS-5A-15-OV-R	5.0
LGS-5A-20-OV-R	5.0
LGS-5A-24-OV-R	5.0
LGS-5A-28-OV-R	5.0



INPUT

- AC Input 105-132 VAC at 47-440 Hz. Input power: 450
Watts₁. Input Current: 6.5 Amps₂. For operation
at frequencies above 440 Hz, consult factory.
- DC Input 145 VDC ± 10%. Input power: 450 Watts₁. Input
current: 3.5 Amps₃.

NOTES:

1. With output loaded to full current rating and 105% of nominal output voltage rating.
2. With output loaded to full current rating, output voltage to 105% of nominal, and input voltage
105 VAC, 60 Hz.
3. With output loaded to full current rating, output voltage to 105% of nominal, and input voltage
130 VDC.

INPUT FUSE — Fuse F101 protects the input wiring to the power supply. Overload of the power supply does not cause failure.

OVERLOAD PROTECTION

- Thermal Thermostat resets automatically when over-
temperature condition is eliminated.
- Electrical Automatic electronic current limiting circuit, limits
the output current to a preset safe value. Automatic
current limiting protects the load and power supply
when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — All LGS-5A models include fixed built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table below for overvoltage protector firing ranges.

MODEL	OVERVOLTAGE PROTECTOR TRIP-POINT RANGE (VOLTS)
LGS-5A-5-OV-R	6.3 — 6.9
LGS-5A-6-OV-R	7.1 — 7.7
LGS-5A-12-OV-R	13.3 — 14.3
LGS-5A-15-OV-R	16.5 — 17.5
LGS-5A-20-OV-R	22.1 — 23.5
LGS-5A-24-OV-R	26.5 — 28.1
LGS-5A-28-OV-R	30.9 — 32.9

INPUT AND OUTPUT CONNECTIONS — Terminal blocks are located on the front of the chassis for input and output connections.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non-operating) — 55°C to 85°C

FUNGUS — All LGS-5A power supplies are fungus inert.

VDC ADJ. Control — The voltage adjust control permits adjustment of DC output over the entire operating range.

PHYSICAL DATA

Size	3-3/16" x 4-15/16" x 15"
Weight	9½ lbs net; 11 lbs. shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — Two surfaces, each with tapped mounting holes can be utilized for mounting this unit. LGS-5A power supplies can be mounted with Top or Right side facing up. The Top or Right side must be in a horizontal plane. Refer to figure 10 for mounting details.

Power supplies must be mounted on one surface only, (either right surface or bottom surface) in a manner so as not to inhibit the air flow for cooling purposes.

ACCESSORIES

Rack Adapters	Rack adapters LRA-14, LRA-15, and LRA-17, used for ruggedized mounting with or without chassis slides, are available.
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EMI/RFI — The LGS-5A is designed to meet FCC Class B and MIL-I-6181D conducted emissions.

UL/CSA — All LG power supplies are designed for underwriters laboratories recognized component index and CSA certification.

MILITARY SPECIFICATIONS — The LGS series has passed the following tests in accordance with MIL-STD-810C.

- 1) Low Pressure — Method 500.1, Procedure I.
- 2) High Temperature — Method 501.1, Procedure I & II
- 3) Low Temperature — Method 502.1, Procedure I.
- 4) Temperature Shock — Method 503.1, Procedure I.
- 5) Temperature — Altitude — Method 504.1, Procedure I. Class 2 (0°C operating)
- 6) Humidity — Method 507.1, Procedure I.
- 7) Fungus — Method 508.1, Procedure I.
- 8) Vibration — Method 514.2, Procedures X & XI.
- 9) Shock — Method 516.2, Procedures I & III.

THEORY OF OPERATION

GENERAL

The LGS-5A series of power supplies consist of an input circuit, two auxiliary power supplies, the main rectifier output and filter (isolated) and the control circuitry. The control circuit is an IC which includes the timing oscillator, operational amplifiers, comparators, and flip flops necessary to perform the control function.

The circuit arrangement is shown in block diagram form in figure 8. The circuitry is discussed with reference to the block and schematic diagrams.

FUNCTIONAL DESCRIPTION

Input Circuit

Single phase AC or DC power is applied to the input bridge rectifiers CR101-CR104 thru the E.M.I. suppression network C101, C102, C103, C104, C105, C106, L101, and L102. Fuse F101 protects the power supply against excessive currents due to internal failure.

The input rectifiers provide power thru R1, C1 and R2 to the auxiliary control circuitry for start up (regulated by CR126). The input rectifiers also provide power for the pulse width modulated inverter.

Auxiliary Power Supply and Start Up

The auxiliary power supply consists of R2, CR126, C109, CR117, Q105 and C112 with power being supplied to Q105 and C112 by C111, R118, CR109, CR128 and CR129 regulated by R119 & CR116. Using C109 & C112 in series to provide the auxiliary source power provides a reference point at approximately 4.5V above the negative rail (negative side C112). This point is common to the emitters of the switch transistors Q1 & Q2 and is utilized as a reference point for start up, current balance, and current limit.

When power is applied to the input terminals, voltage is applied to CR126 & C109 thru R2. Voltage is also applied thru R1 terminal 10 of comparator IC 101B. When this voltage exceeds the voltage at terminal 11, then the output goes low, turning on Q101, thus applying 9.1V to terminal 16 of IC102. This starts IC102 producing an output pulse at either terminal 2 or 14. It should be noted that resistors R133, 153 and capacitor C129 are returned to the anode terminal of CR126. R152 provides hysteresis to maintain the necessary holdup time in the event of power failure.

It should also be noticed that at initial turn on, power is supplied to drive transistors Q102 & Q104 thru CR127 and R150; after initial start up, CR127 is back biased.

Pulse Width Modulated Inverter

Positive and negative pulses are provided to the primary of T1 by the alternate conduction of Q1 and Q2. The duration of these pulses is determined by the conduction time of Q1 and Q2. This time is determined by the duration of drive pulses applied to the bases of Q102 and Q104 as provided by IC102.

When Q102 turns on, voltage is applied directly to the base of Q1 (Q103 is biased off). When the pulse provided by IC102 turns off, Q102 turns off & Q103 is turned on since R104 and the collector of Q103 are returned to the point 5 volts negative with reference to the emitters of Q1 & Q2. Diode CR117 prevents these turn off pulses from interfering with the other functions of the control circuit.

Diode CR110 and resistor R103 prevent saturation of Q1, which would extend the turn-off time.

Control Circuitry

The control circuitry is made up of IC104, IC103, IC102, IC101 and all associated components.

IC102 contains a free running oscillator, with R147 and C126 being the timing components. C126 controls the dead time (reset time of the ramp generator) which is approximately 3 micro-seconds. R147 controls the rise time of the ramp which is approximately 24 micro-seconds. The wave form as measured at terminal 10 rises about 1.0 volt from 1.3 to 2.3 volts. The output timing pulse can be observed at terminal 9.

The error operational amplifier input is terminals 5 & 6 of IC102 with the output being observed at terminal 7. Compensation components C124 and R144 provide a gain of approximately 2. R135 and R136 provide a reference voltage for terminal 5, with the error voltage from IC103 terminal 4 being applied to the negative input terminal 6. C120 and R132 are frequency compensation components.

Current balance and current limit information is developed across R3. The balance information is referenced to the emitters of Q1 and Q2. The balance signal across R3 is then AC coupled and superimposed on the DC reference signal at terminal 5 of IC102.

The current limit section of IC102 requires a pulse to activate the function. Upon being pulsed the current limiter latches on and remains on thus removing any output pulses from terminals 2 and 14. At the end of each 27 micro-second period the internal sync pulse resets the current limit.

The current limit information is developed across R3 and applied to terminals 6 and 7 of comparator IC101A. Upon being activated, the output at terminal 1 goes positive and is applied to terminal 4 of IC102. When terminal 4 exceeds 2.4 volts positive the current limit function is activated and latched.

R142 adjusts the offset voltage with a clockwise notation reducing the maximum current available at the output terminals of the power supply. CR125 prevents the voltage at terminal 7 of IC101A from going more than .5V negative.

C121, R137 and CR123 prevent overshoot on initial turn on with CR123 providing fast recovery of C121 upon power interruption.

When the current limit is activated a time delay of 1 to 3 micro-seconds is encountered before Q1 or Q2 are actually turned off due to transistor characteristics. As a result a frequency shift circuit is activated when the pulse width is reduced to approximately 6 micro-seconds. This frequency shift is necessary to prevent excessive short circuit current at the output of the power supply. R113, CR109, R121, R120, C113, CR118 thru CR122 and R107 are the frequency shift components. Since the frequency shift is activated during the "off" time (neither Q1 or Q2 conducting), the voltage at the junction of CR129 and CR128 anodes (cathode of CR109) will be the voltage at the emitters of Q1 and Q2 plus one diode drop due to CR128 & CR129 being pulled positive by R113. This voltage is approximately 5.1 volts.

In the "on" (Q1 or Q2 conducting) mode the voltage at the junction of CR128 & CR129 is about 10 or 11 volts negative (CR109 conducting). This pulsed wave form is clamped to 0.8 volts positive (during "off time") and 0.8 volts negative (during "on time") at the junction of CR118 and CR120. This voltage is fed into an integrator (C113 and R120) to average this voltage. As the pulses become narrower the integrated voltage increases in the positive direction and is coupled thru CR122 to terminal 11 of IC102. Thus when the current limit function is activated and the voltage at terminal 11 is above the threshold voltage of .418 volts the frequency will shift up to 25 times depending on the voltage at terminal 11. Caution should be taken to never apply voltage directly to terminal 11 as internal damage may occur to the chip. The purpose of CR122 is isolation, of terminal 11, IC101 during normal operation.

The voltage sense information is fed thru R116, R122, R123, R124, R117, and R125 to IC104 terminal 3 and compared with the 2.5 volt reference voltage at terminal 2. The operational amplifier provides about 75DB of gain with the output at terminal 6 applied to terminal 1 of IC103 (diode section).

IC103 is an optical coupler and is used to provide isolation of the DC output of the power supply from ground and power input. C125, R143, R131, C119, R130 and C117 are frequency compensation components.

CR130 provides fast recovery on transient response. R126 and R127 provide a voltage divider network to limit current thru the diode section of IC103.

Output Circuit

Positive and negative pulses supplied by T1 secondary are rectified by full wave rectifiers CR1, CR2 and, as applicable, CR3 and CR4, filtered by filter network L1 and C2, and supplied to the output by E.M.I. suppression network C3, C4, C5, C7, C8, C9, L2 and L3.

Over Voltage Circuit Operation

When the output voltage reaches the trip point of the over voltage module, the module fires crow-barring the output of the supply. The current through the module is sensed by current sensor L103. The output of L103 triggers SCR101, crow-barring the logic circuitry and turning the inverter off.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When the load current exceeds the 40°C rating, voltage decreases toward zero and the current at short circuit is held to a safe value.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying power.

Ground Connections. The Lambda power supply can be operated either with the negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams illustrated in this manual for all suggested output connections.

Connection Terminals. Make all connections to supply at the terminal block on the front of the supply. Apply input power to terminals 1 and 2. Always connect the ungrounded AC or DC lead to terminal 1.

The supply positive terminal is brought out to terminal 7. The supply negative terminal is brought out to terminal 6. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the front output terminals. Connect measuring devices directly to the terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of partial length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs. Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation. Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms. As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections for Series Operation, Figure 7. The voltage capability of LGS-5A power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the main rectifier heat radiator exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown. When the power supply voltage increases above the overvoltage limit, HC1 will short circuit output of the supply and SCR101 will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the AC input circuit. (refer to TROUBLE SHOOTING CHART)

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

OPENING UNIT FOR TROUBLE SHOOTING AND REPAIR

Whenever it is necessary to trouble shoot and repair the Lambda LGS-5A power supply, open the unit as follows:

1. Remove cover by removing 14 screws securing cover to chassis.
2. Remove:
 - a. 2 screws holding front deck to chassis.
 - b. 2 screws holding chassis to heat sink.
 - c. 3 screws holding printed circuit board to chassis.
3. Separate the two sections of chassis & printed circuit board with front deck and heat sink.
4. Power supply components are now accessible for trouble shooting and repair.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failure and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

CAUTION: Make sure components and P.C. board are not shorting to chassis when power is applied.

1. Use ohmmeter to check Q1, Q2, Q101, Q102, Q103, Q104 & Q105 with no power applied. Also check fuse, R1 and check for short across C1. Check zener diodes CR126 and CR116 for short or open.

When using an ohmmeter to check semiconductors, observe proper polarity for PNP or NPN devices to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails causing other parts to fail. Replacing only one transistor and turning power on before checking for additional faulty components could damage the replaced component.

In the event Q1 or Q2 has failed, be sure to check the associated transistors Q102 and Q103 or Q104 and Q106.

After the bad parts have been replaced, remove the wire at the positive terminal of C1 that connects to terminal 26 on the PC board so that when power is applied, only the PC board is activated and the inverter is inoperative.

NOTE: The voltage from the cathode of CR126 to terminal 8 of IC102 will be approximately 9 volts since the inverter is inoperative.

Check for proper output pulses at terminals 2 and 14 of IC102 and proper output pulses at the bases of Q1 and Q2 (terminals 17 and 18 on the PC board).

NOTE: It may be necessary to temporarily short terminals 3 and 4 of IC102 together to obtain output pulses. This resets the current limit function.

When soldering semi-conductor devices, care should be taken not to apply heat to the lead for more than 10 seconds without letting the device cool down.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases, the capacitors are shunted with resistances — some of which have low values. Only a dead short is a true indication of a shorted condition.

After the P.C. board has been determined to be functioning properly, it is advisable to connect a 50 ohm (25 to 50W) resistor in series with the lead from terminal 26 on the PC board to capacitor C1. Upon applying power at no load, check to determine that all pulses are normal and that the voltage from the cathode of CR126 to terminal 8 of IC102 is approximately 14.7 volts. If the switch transistors Q1 & Q2 are functioning properly and the proper output voltage is obtained, then the 50 ohm resistor may be removed.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good conductor. Do not attempt to cover with solder.
2. When making voltage measurements, use a needle point probe to penetrate thru the protective coating to the wiring.
3. Always use a heat sink when soldering transistors, a transistor pad with mounting feet is an effective heat sink.
4. Broken or damaged painted wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hookup wire to bridge the break, and holding wire in place, flow solder along the length of wires so that it becomes part of the circuitry. Clean protective coating from trace before soldering. Avoid excessive heat.
5. When unsoldering components from the board never pry or force the part loose. Unsolder the component by using a solder removing tool or the wicking process described below:
 - a. Select a 3/16 inch tinned copper braid for use as a wick. If braid is not available, select AWG #14 or #16 stranded wire with at least 1/2" or more insulation removed.
 - b. Dip the wick in rosin flux.
 - c. Place the wick onto the soldering connection and apply soldering iron onto the wick.
 - d. When a sufficient amount of solder flows onto the wick, free the component carefully.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and should be used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

- a. AC power of proper voltage and frequency is present at input terminals.
- b. Either the positive or negative terminal is connected to chassis ground.
- c. The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.
- d. If power supply is totally inoperative it is advisable to disconnect the supply voltage lead from capacitor C1 to terminal 26 on the P.C. board.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT AND ARE REFERENCED TO LINE VOLTAGE. USE A 0.5 KVA ISOLATION TRANSFORMER TO ISOLATE POWER SUPPLY FROM LINE. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

TROUBLE SHOOTING CHART

<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
1. Zero volts DC output; voltage across C1 reads zero.	Open F101, R1, CR101-CR104. (shorted Q1, Q2)	Check & replace as necessary. Check Q1, Q2, Q102, Q103, Q104, Q106 and IC102 for secondary failure.
2. Zero volts DC out. Voltage across C1 correct. Voltage across C109 correct.	Q101, IC102, IC101, R3 open. Q1 & Q2 open.	Check and replace as necessary. Check Q1, Q2, Q102, Q103, Q104, Q106 and IC102 for secondary failure.
3. Zero volts DC output; voltage across C1 correct; voltage across C109 zero.	Thermostat S1 closed.	If thermostat, refer to table 1 of specifications and features for current ratings at given ambient temp. After allowing time for the power supply to cool, resume operation of the supply.
	CR126 shorted, R2 open.	Check and replace as necessary.
	SCR101 shorted.	Check and replace as necessary. Check O.V.
	SCR101 fired due to OV condition.	Momentarily interrupt AC input, if supply operates normally, a transient has occurred in line or load. Check wiring (switches, etc.). If supply fails to reach full output voltage remove AC input, disconnect +V terminal of HC1, remove load, apply AC power if output exceeds rating refer to symptom "Output too high."

TROUBLE SHOOTING CHART

<u>Symptom</u>	<u>Possible Cause</u>	<u>Remedy</u>
4. Output voltage too high.	IC102 faulty, IC103 open, IC104 faulty, bad wiring	Check and repair as necessary.
5. Very low output voltage, voltage across C109 and C112 correct. Voltage across C1 correct.	IC104 faulty, IC102 faulty, IC103 faulty, bad wiring, HC1 fired or faulty.	Check and repair as necessary.
	Shorted output.	Check wiring etc. and repair as necessary.
	Faulty R142.	Check and repair as necessary.
6. High ripple	Q1 or Q2 open. Shorted transistor block to chassis, Q102 open, Q104 open, IC102 faulty, C2 faulty, L1 shorted.	Check and repair as necessary.
7. Pulse repetition period very long no load.	IC102 faulty.	Check and replace as necessary.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 9. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter; DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to loaded condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 132-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a VTVM Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use the oscilloscope to measure peak to peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CURRENT LIMIT CONTROL R142.

When ever IC101, R3, R140, R139 or CR125 are replaced it may be necessary to readjust R142. The adjustment procedure requires that the power supply be removed from its associated equipment, is at an ambient temperature of 25°-30° C, and is stabilized and not operating.

1. Remove AC input power to the supply.
2. Break the seal on the adjustment screw to R142.

3. Operate the power supply for constant voltage with local sensing connected as shown in figure 3, at no load, with an AC input of 132 VAC, 60 Hz.
4. Apply load so that the output current is 110-115% of the 40°C rating for the unit.
5. Using an oscilloscope, Tektronix 503 or equivalent, observe the output voltage while adjusting R142. Clockwise notation reduces the current limit while counterclockwise notation increases the current limit. If the unit is already in current limit (noted by reduced output voltage) turn R142 counterclockwise until the unit is back in constant voltage mode. Turn R142 clockwise until the output ripple increases sharply as indicated by the oscilloscope.
6. Double check that current limit is activated at 110% to 115% of rated load then use glyptol sealant to seal the screw of R142.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

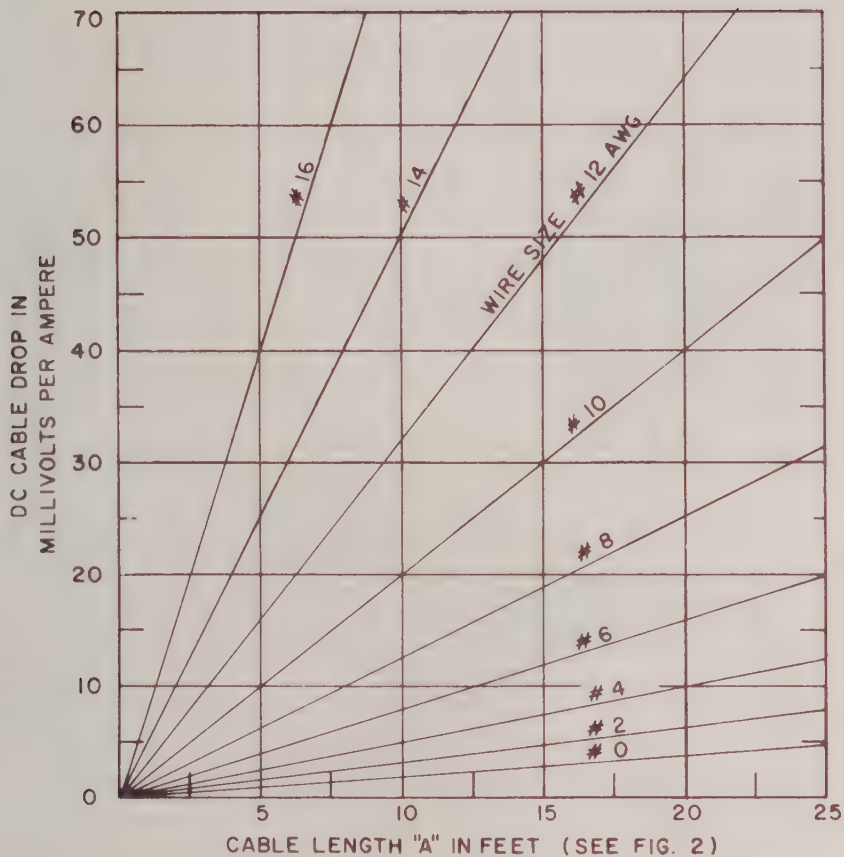


Figure 1. Cable Connection Chart

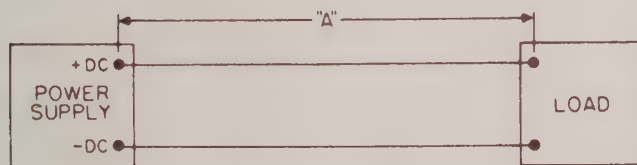
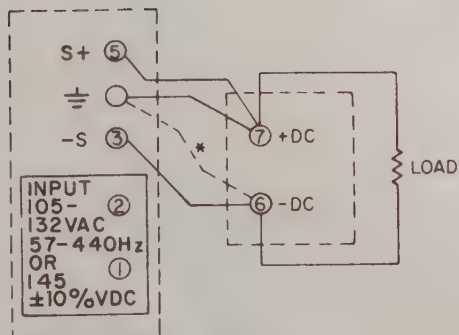
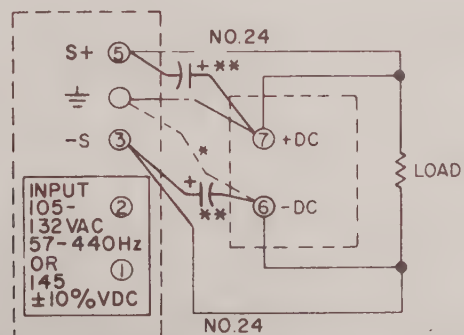


Figure 2. Cable Length "A" in Feet



* FOR NEGATIVE GROUND DISCONNECT JUMPER FROM TERMINALS 4 AND 7 AND RECONNECT TO TERMINALS 4 AND 6.

Figure 3. Local Sensing Connections



* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 4 AND 7 AND RECONNECT TO TERMINALS 4 AND 6.
 ** A2.5MF, ELECT. CAP MAY BE REQUIRED.

Figure 4. Remote Sensing Connections

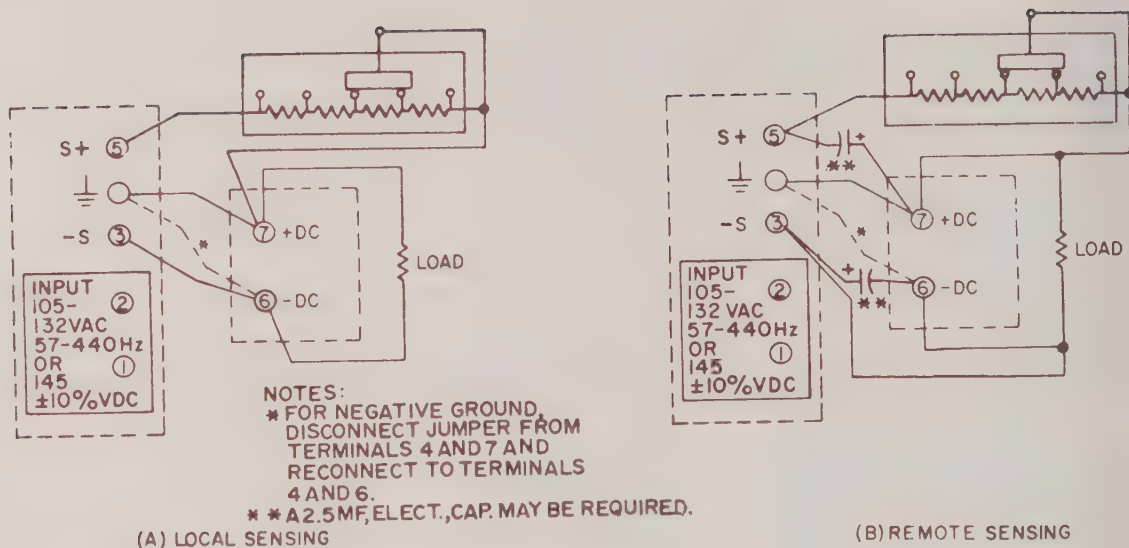


Figure 5. Programmed Voltage, with External Resistor

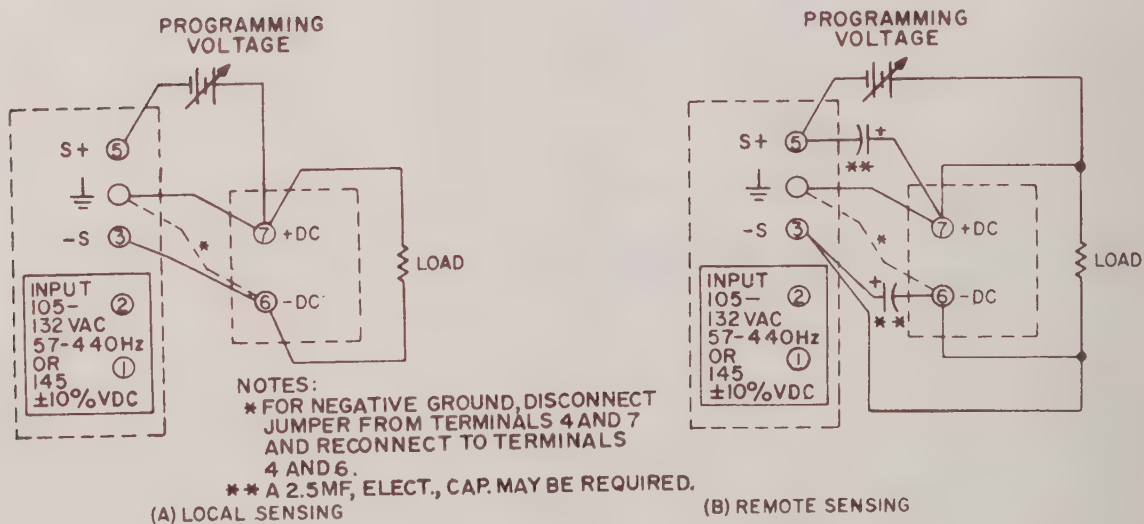
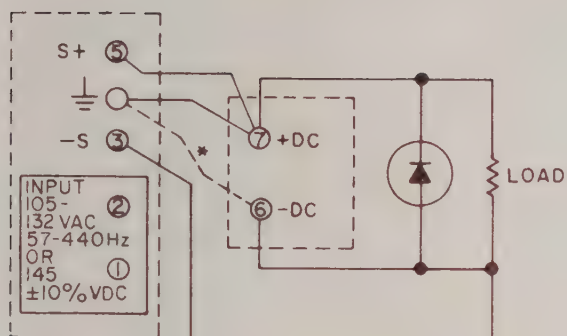
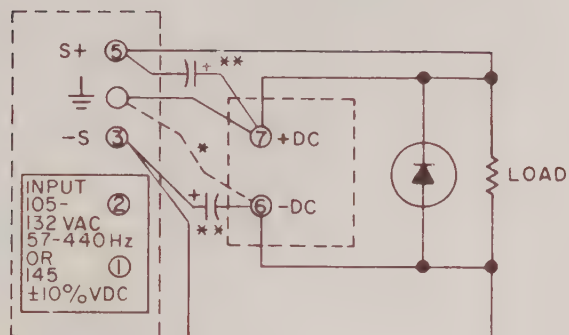


Figure 6. Programmed Voltage, with External Programming Voltage Source



(A) LOCAL SENSING



(B) REMOTE SENSING

NOTE:

- * MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 4 AND 7 ON TOP UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.
- ** A 2,5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 7. Series Connection

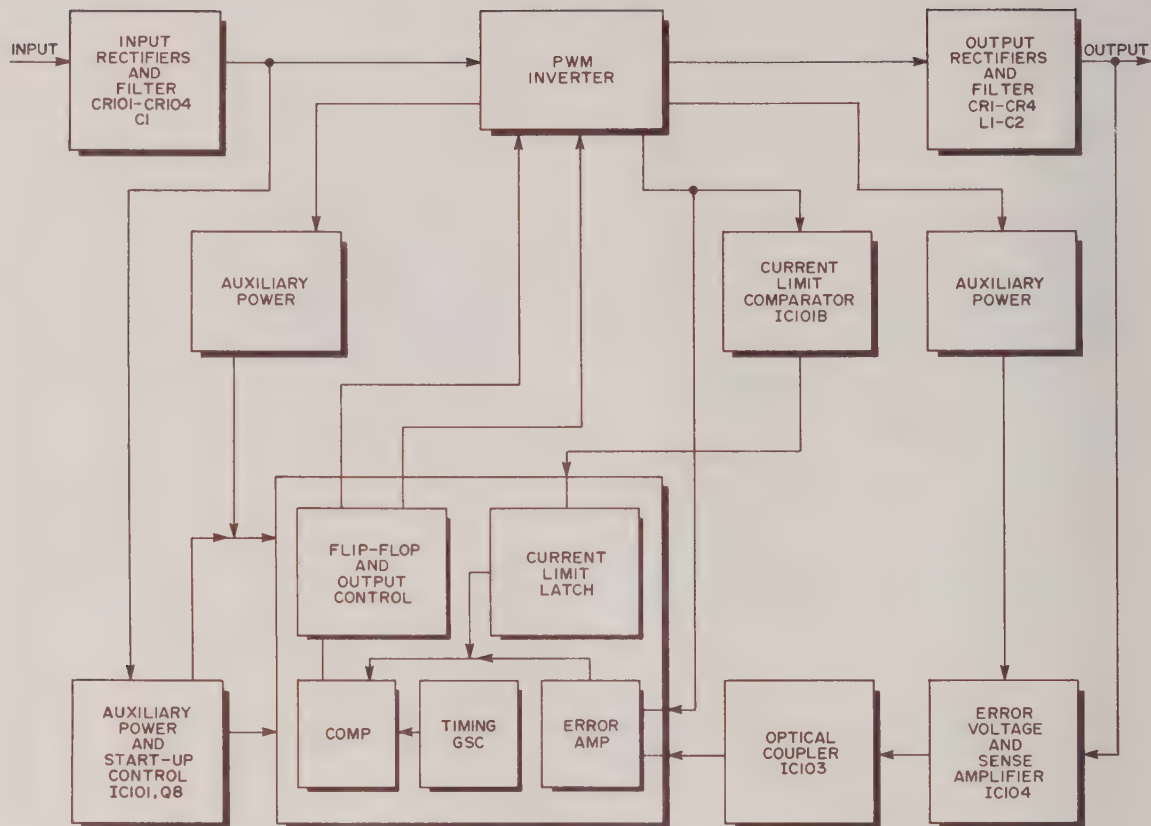


Figure 8. Typical Block Diagram

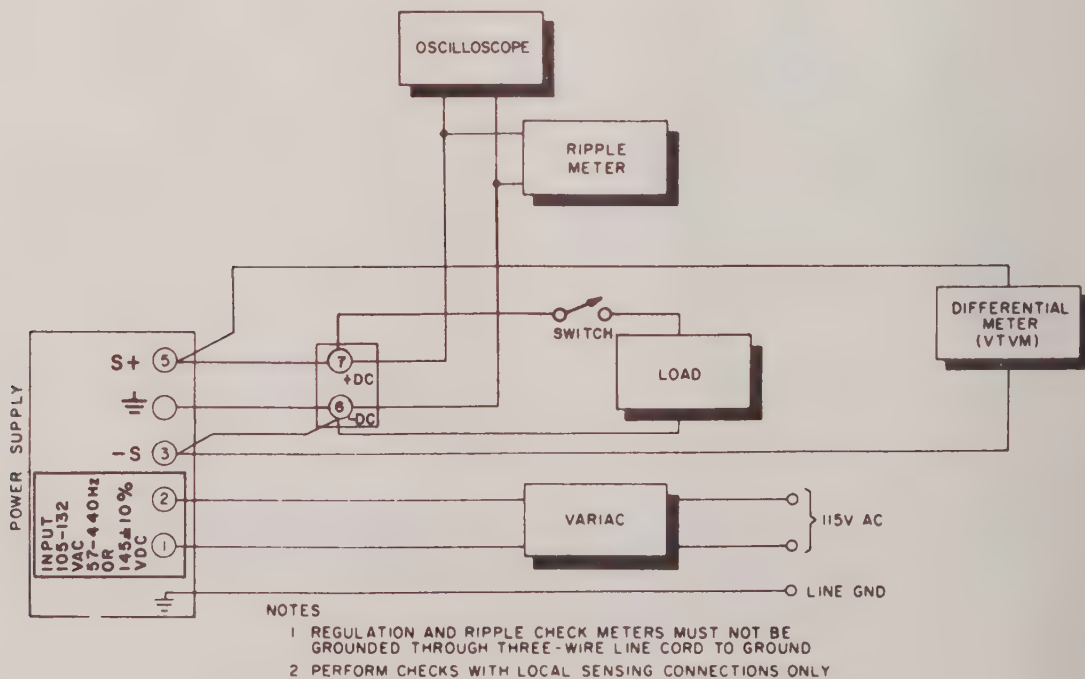


Figure 9. Test Connections for Performance Checks



MODELS	
LGS-5A-5	OV-R LGS-5A-20-OV-R
LGS-5A-6	OV-R LGS-5A-24-OV-R
LGS-5A-12	OV-R LGS-5A-28-OV-R
LGS-5A-15	OV-R

Λ LAMBDA

ELECTRONICS
MELVILLE, NEW YORK

FOR WIRING OF POWER SUPPLY
TO LOAD REFER TO SUPPLY - TO -
LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN ON
TBI INDICATE JUMPERS IN PLACE
FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS
BEARING SERIAL NO. PREFIXES A-F

ARE TAKEN BETWEEN INDICATED POINTS AND 01.02
EMITTERS UNLESS OTHERWISE INDICATED
CR12, CR13, CR106, CR108 ONLY USED ON UNITS WITH
REFLEXES A,B,C AND CS NOT USED ON UNITS WITH BERNAL NO.
REFLEXES A,B,C
R124 WAS 2.2K $\pm$ 2%, R126 WAS 2.2K, R122 WAS 5K
R120, W AND R150 NOT USED ON UNITS WITH
BERNAL NO PREFIXES A-C

— INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
○ INDICATES COMPONENT OR CONNECTION POINT.
— DESIGNATIONS ARE LAMBDA PART NUMBERS.

SEE TABLE I FOR COMPONENT VALUES
CONDITIONS FOR CIRCUIT POINT MEASUREMENTS:
① V_{AC} 57-63Hz; NOMINAL VOLTAGE, NO LOAD
② S AND U .5 AMP; 5-V SHORTED; INDUCTIVE
LOADS ARE APPLIED ACROSS AMMETER DC LEADS
③ OTHER THAN 0.001 OHMS/VOLTMETER VOLAGES IN PARENTHESES
ARE TAKEN BETWEEN INDICATED POINTS AND -S
UNLESS OTHERWISE INDICATED OTHER VTAGES

RESISTORS ARE 1/4W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
RESISTOR TOLERANCES: COMP $\pm 10\%$, FILM $\pm 1\%$, WIREWOUND $\pm 5\%$.
CAPACITOR TOLERANCES: ELECTROLYTIC -10 to $+70\%$, METAL FILM $\pm 10\%$, MYLAR $\pm 10\%$ UNLESS OTHERWISE NOTED.
SYMBOLS
[] INDICATES ACTUAL UNIT MARKING
↑ INDICATES CLOCKWISE ROTATION OF SHAFT
* SEE INSTRUCTION MANUAL.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-5A-5-0VR - LGS-5A-28-0VR

SCHEMATIC COMPONENTS										
MODEL	C2	C125	CR1, CR2	CR3, CR4	HC-1	R4	R122	R123	R143	R155
	ELECT -10 +100%	MYLAR ±10%	*FBL-00-	*FBL-00-	*L-20-0V-	WW 5%, 10W	CERMET ±10%, ½W	FILM ±1%, ¼W	FILM ±1%, ½W	FILM ±1%, ¼W
LGS-5A-5-0VR	45,000 mf 7.5V	NOT USED	197	NOT USED	5	5.0	2.5K 1W	1.5K	NOT USED	2.32K
LGS-5A-6-0VR	45,000 mf 7.5V	NOT USED	197	NOT USED	6	5.0	2.5K 1W	2.37K	NOT USED	3.65K
LGS-5A-12-0VR	19,000 mf 30V	NOT USED	197	NOT USED	12	37	5.0K	7.68K	NOT USED	7.68K
LGS-5A-15-0VR	15,000 mf 30V	0.015 mf 80V	197	NOT USED	15	75	5.0K	10.2K	3.48K	19.6K
LGS-5A-20-0VR	10,000 mf 40V	0.015 mf 80V	199	199	20	100	10.0K	14.7K	2.21K	10.2K
LGS-5A-24-0VR	6,300 mf 50V	0.01 mf 80V	199	199	24	150	10.0K	18.2K	1.18K	16.2K
LGS-5A-28-0VR	6,300 mf 50V	0.01 mf 80V	199	199	28	250	10.0K	20.5K	2.15K	30.9K
* LAMBDA PART NO.										



5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS

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INSTRUMENTS INC.

MP MASTER



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